INSTRUMENT
CAL LAB

INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LV-E SERIES

MP MASTER
MA28937

LAMBDA

LAMBDA ELECTRONICS CORP.-MELVILLE, L. I., N. Y.

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

LV-E SERIES

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics Corp. All information contained herein applies to all LV-E models unless otherwise specified.

LAMBDA ELECTRONICS CORP. MELVILLE, L.I., N.Y.
MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LVE

TABLE OF CONTENTS

Section	Page
SPECIFICATIONS AND FEATURES	1
THEORY OF OPERATION	4
OPERATING INSTRUCTIONS	6
Basic Mode of Operation	6
Mounting	6
Connections for Operation	6
Supply-Load Connections	7
Operation After Protective Device Shutdown	7
MAINTENANCE	9
General	9
Trouble Analysis	9
Checking Transistors and Capacitors	9
Printed Circuit Board Maintenance Techniques	10
Trouble Chart	10
Performance Checks	13
Adjustment of Calibration Control, R129	13
Adjustment of Ripple Filter Calibration Control, R140	14
Overvoltage Adjustment Procedure	14
SERVICE	15
PARTS ORDERING	15

SPECIFICATIONS AND FEATURES

DC OUTPUT -- Voltage Regulated for line and load.

Voltage Range	For voltage range see table I of pertinent model group.
Multi-Current Ratings . . .	Current ratings specified for each maximum ambient temperature apply over entire output voltage range, with input frequency 57-63 Hz.

For maximum current ratings at each ambient temperature, see table I of pertinent model group.

REGULATED VOLTAGE OUTPUT

Regulation (line)	0.15% + 10 mV for line variations from 105-132 or 132-105 volts AC.
Regulation (load)	0.15% + 10 mV, no load to full load or full load to no load, throughout voltage range.
Remote Programming	
External Resistor . . .	Nominal 200 ohms/volt output.
Programming Voltage . .	One-to-one voltage change.
Ripple and Noise	10 millivolts rms, maximum.
Temperature Coefficient . .	Change in output voltage (0.03% + 0.5 mV)/°C.

AC INPUT -- 105-132 volts AC at 57-63 Hz. Maximum input power*: 450 Watts.
*With output loaded to full 40°C rating and input voltage 105 volts AC, 60 Hz.

INPUT FUSE -- Fuse F1 protects the AC input circuit. Overload of the supply does not cause fuse failure.

OVERLOAD PROTECTION

Thermal	Thermostat resets automatically when overtemperature condition is eliminated.

Electrical

External . . . . . Automatic, electronic current limiting circuit limits output current to less than 120% of 40°C rating for protection of load and power supply.

OVERSHOOT -- No overshoot of output voltage under conditions of power turn-on, power turn-off, or power failure.

INPUT CONNECTIONS -- Heavy duty terminal block on rear of chassis.

OUTPUT CONNECTIONS -- 1/4" x 28 studs on rear of chassis.

CONTROLS

DC Output Control . . . . . Voltage adjust control permits adjustment of DC output voltage via access hole located in nameplate.

Overvoltage Control . . . . OV ADJ. control permits setting the over-voltage protection point.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE -- Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE -- -55°C to +85°C.

OVERVOLTAGE PROTECTION -- All LV-E models include a built-in overvoltage protection circuit which prevents damage to the load that can be caused by excessive power supply output voltage.

REMOTE SENSING -- Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

PHYSICAL DATA

Size . . . . . 4-15/16" H x 7-1/2" W x 11-3/4" D.

Weight . . . . . 40 lbs. net, 50 lbs. shipping wt.

Finish . . . . . Grey, FED. STD. 595 No. 26081.

MOUNTING -- Three surfaces, each with tapped mounting holes, can be utilized for mounting this unit. Unit must be mounted so that radiator fins are always vertical. Refer to figure 9 for mounting details.

ACCESSORIES

Rack Adapters -- Rack adapters LRA-4 and LRA-6, used for ruggedized mounting, with or without chassis slides, are available, as well as rack adapters LRA-3 and LRA-5 which are used for simple rack installations where chassis slides are not required.

THEORY OF OPERATION

The Lambda power supply consists of an AC input circuit and transformer; a secondary power circuit consisting of SCR(s), a filter choke and output capacitors; a bias supply consisting of rectifiers and a zener diode regulator; a main regulator circuit, which includes a zener reference, voltage and current comparators, output voltage and current sensing circuits and a triggering circuit.

All Lambda LV series power supplies are provided with an electronic ripple filter consisting of a D.C. biasing circuit and an AC amplifier.

The circuit arrangement is shown in block diagram form in figure 7. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Single phase input power is applied to transformer T1 through the input circuit consisting of fuse F1, thermostat S1, and RFI coil L3.

T1 secondary voltage is regulated by varying the conduction angle of SCR1, SCR2; an increase in conduction angle causes an increase in output voltage from T1. The output of T1 and SCR1, SCR2 is filtered by L1 and capacitor C1.

Bias supply voltage provided by full wave rectifiers CR103, CR104 is filtered by capacitor C101 and regulated by regulator circuit Q101, R103, R105, and CR106. Temperature compensated reference voltage for the current limiter IC102, and the voltage regulator circuit is provided by R127 and CR116.

Conduction angle of SCR1, SCR2 is determined by the charging current into C102. When the voltage on C102 exceeds the firing-point voltage of unijunction transistor Q104, Q104 breaks down and transfers energy to pulse transformer T101. The secondary of T101 provides triggering pulses to the gate of SCR201. Each time the line voltage drops to zero, the zero-crossing voltage detector, composed of R101, R102, R104, CR101, CR102, CR105, and IC101, discharges C102. This action synchronizes charging capacitor C102 with the line voltage. As the charging current through C102 is increased, the charging time decreases. A decrease in charging time causes the SCR conduction angle to increase, causing the output voltage to increase accordingly.

Operation of the voltage regulator circuit is determined by changes in the output voltage. A change in output voltage is sensed by sensing divider resistors R8, R135 and R137 (and as applicable, R136) which compare output voltage with the +S reference voltage. The error voltage generated at the junction of these two resistors is amplified and fed to IC101 which causes the charging rate of capacitor C102 to change. As explained previously, a change in charging current, causes a change in SCR conduction angle, restoring output voltage to the proper level.

Current-limit circuit operation is determined by changes in the load. IC102 samples load current through resistor RS1. When the voltage drop in RS1 exceeds the voltage across R129, current comparator IC102 conducts through diode gate CR113, and a negative input signal is provided to IC101. The signal is amplified by IC101, resulting in a decrease of charging current into C102 and a decrease in the conduction angle of SCR1 and SCR2. This action limits the power supply output current. R116 and R119 provide a bias to IC102. An increase in bias voltage to IC102 causes the output current and voltage to decrease. When the load reaches short circuit, the output voltage drops to zero and the output current is maintained at a predetermined level.

RIPPLE FILTER, FUNCTION DESCRIPTION

The active ripple filter consists of a reference zener CR117 and a DC-AC coupled amplifier IC103. DC coupling is used to set the operating point of driver Q2 and power transistors Q3 and Q4.

Voltage developed across RS2 is proportional to the D.C. current in Q3 and Q4. This D.C. voltage level is kept equal to voltage across R140. Q106 and Q2 provide current gain for the main power stages Q3 and Q4.

C108 provides A.C. coupling from the output to IC103. An increase in output voltage causes an input rise to IC103 and an increase in current through Q3, Q4. The current through these transistors assumes the same waveshape as the ripple component in choke L1. The average value of current through the ripple filter power transistors is determined by the setting of R140. The AC component of choke current flows into the ripple filter, rather than into C1, thus minimizing the output ripple voltage.

OVERVOLTAGE PROTECTOR, FUNCTION DESCRIPTION

Divider network R158, R159, R160, R161, R7, attenuate the power supply output voltage. When the power supply increases above the overvoltage limit set by R7, the attenuated voltage of the divider network also increases, biasing transistor Q108 on. Q108 in turn biases Q107 on through resistor R155. Q107 supplies gate current to SCR101. SCR101 turns on SCR3 which places an effective short circuit across the power supply output.

OPERATING INSTRUCTIONS

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature and will remain limited to less than 120% of 40°C rating.

MOUNTING

When using this unit as a mounted component, a cutout must be provided to permit free-flow of air through the unit. See figure 9 for mounting details.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated with either negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal block and studs on the rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded (hot) lead to terminal 1.

The supply positive terminal is brought to terminal 6; the negative terminal is brought out to terminal 4.

NOTE: When shipped from the factory, the supply is ready for use as a local sensing constant voltage source. Jumpers are connected at the factory as shown in figure 3. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram.

Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 6. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

The regulation of the supply at the load may change when connecting leads of practical length are used. To minimize the effect of output load leads, remote sensing is used. Refer to figure 1 to determine voltage drop for particular cable lengths, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local-Sensing Connection, See Figure 3.

Remote-Sensing Connection, See Figure 4.

Programmed Voltage Connection Using External Resistor, See Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at nominal 200 ohms/volt and a shorting-type switch. For continuous voltage variations, use a variable resistor with the same ohms/volt ratio in place of the voltage divider and shorting-type switch. Use low temperature coefficient resistor(s) to assure most stable operation.

Programmed Voltage Connection Using Programming Voltage, See Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply.

The programming supply must have a reverse current capability of 6 ma. minimum.

Alternatively, when supplies with less than 6 ma. reverse current capability are used, a resistor capable of drawing 6 ma. at the minimum programming voltage must be connected across the output terminals of the supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Operation After Thermostat Shutdown. The thermostat opens the input circuit only when the power supply output current exceeds the current rating specified for the operating ambient temperature, causing the unit to overheat. Do not exceed current rating specified for the operating ambient temperature. When the temperature of the unit decreases to a safe operating value, the thermostat will reset automatically.

Operation After Fuse Shutdown. Internal component failure is prevented by fuses which protect the components from damage caused by excessive currents. Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures

are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

Overvoltage Shutdown. When the power supply output voltage increases above the preset overvoltage limit, OVSCR3 will short circuit output of the supply. After eliminating the cause(s) for overvoltage, resume operation of the supply by momentarily interrupting the AC input power.

MAINTENANCE

GENERAL

This section describes trouble analysis routine, calibration and test procedures that are useful for servicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on specifications and features for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before troubleshooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumpers and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 7, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal no load operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an in-circuit transistor checker. If no checker is available, transistors can be checked with an ohmmeter that has a highly limited current capability. Observe proper polarity for PNP or NPN to avoid error in measurement. The forward transistor resistance is low but never ZERO; backward resistance is always higher than the forward resistance.

Do not assume trouble is eliminated only when one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional faulty components could damage the replaced component.

When soldering semi-conductor devices, hold the lead being soldered with a pair of pliers or a commercial heat sink device placed between the component and the solder joint.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low value. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to measuring instrument.

3. Always use a heat sink when soldering transistors; a transistor pad with mounting feet is an effective heat sink.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

   (a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

   (b) Dip the wick in liquid rosin flux.

   (c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

   (d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

(a) AC power of proper voltage and frequency is present at input terminals.

(b) Either positive or negative terminal is connected to chassis ground.

(c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

TROUBLE CHART

Symptom	Probable Cause	Remedy
1. Zero volts DC output	No input power, thermostat S1 open, fuse F1 open.	Check power source; line cord, F1, shut off unit and allow to cool and check ambient temperature.
	Improper output terminal connection.	Refer to appropriate connection diagram and check for correct connections.
	CR115, CR116, CR106, CR107, C1, C2, C101, C102, C104, C106 shorted.	Check and replace as required.
	R101, R106, R108, R112, R128, R130, R135 open.	Check and replace as required.
2. Unable to adjust output voltage.	Damaged VDC adjust control.	Check R8 for short and/or open; replace as necessary.
	Supply in current limiting.	Remove load and check for shorts and/or improper supply-load connections; refer to appropriate diagram for correct connections.

TROUBLE CHART (Cont'd.)

	Symptom	Probable Cause	Remedy
3.	Output voltage too high	Improper output terminal connection.	Refer to appropriate connection diagram and check for correct connections.
		Faulty CR116, R135, R136, R137, RS1, R132, Q102, SCR1, SCR2, SCR201	Check for high voltage across CR116; R135, R136, R137, RS1, R132 for open; Q102 and SCR(s) for short.
		Q107, Q108, SCR201 shorted R160 open.	Check and replace as required.
4.	Output voltage too low	Excessive load.	Check value of load for compatibility with power supply ratings.
		Line voltage too low.	Check and correct AC input voltage at load terminals.
		Faulty CR116, CR106, R132, R135, R136, R137.	Check CR116 for low voltage;check for shorts in R132, R135, R136, R137.
5.	Unit unstable	Faulty C104, C106; C105 shorted, R114, R115 open; SCR1, SCR2, SCR201 open or shorted; CR101, CR102 open; C1, open.	Check and correct as necessary.
6.	Excessive ripple (120 Hz.)	C1 open; L1 shorted.	Check and correct as necessary.
7.	Poor regulation	Supply in current limiting.	Remove load and check for shorts and/or improper supply-load connections; refer to appropriate diagram for correct connections.

TROUBLE CHART (Cont'd.)

Symptom	Probable Cause	Remedy
Poor regulation (cont'd)	R129 improperly adjusted.	See ADJUSTMENT OF CALIBRATION CONTROL, R129 for proper current limit control setting.
	Q101, R105 shorted.	Check and replace as required.

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 8. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC VTVM (John Fluke Model 825A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the full load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL, R129

Whenever IC101, CR116, R116, R119, R129, R125, or RS1 are replaced, adjust R129 as follows:

1. Remove AC power input to the supply.
2. Unsolder wiper of R129 from resistor housing and turn to full CW position.
3. Apply AC power to the supply at 105 Vac.
4. Operate power supply with local sensing, connected as shown in figure 3, with no external load.
5. Turn voltage adjust control until minimum, rated output voltage is obtained.
6. Apply load so that output current is 110% of 40°C rating for the unit.

7. Adjust R129 CCW until output voltage falls below regulation limits. Short circuit current should be below 120% of 40°C current rating.

8. After adjustment is completed, remove AC power input to the supply and solder wiper of R129 to resistor housing.

9. Reapply AC power, check load regulation and short circuit current. Repeat adjustment procedure if required.

ADJUSTMENT OF RIPPLE FILTER CALIBRATION CONTROL, R140

Whenever CR117, R139, R149, RS2, RS1 and IC102 are replaced, adjust R140 as follows:

1. Remove AC power to the supply.

2. Unsolder wiper of R140 from resistor housing and turn to mid-point position.

3. Apply 132 VAC input power to the supply.

4. Operate power supply with local sensing connected as shown in figure 3, with no external load.

5. Turn voltage adjust control until minimum rated output voltage is obtained.

6. Apply load so that maximum 40°C rated output current is obtained.

7. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R140 in a CCW direction. Turn R140 until output ripple increases sharply and oscilloscope pattern changes.

8. Turn R140 until large negative-going spikes just disappear.

9. After adjustment is completed, remove AC power input to the supply and solder wiper of R140 to resistor housing.

10. After soldering check setting and repeat adjustment procedure if required.

OVERVOLTAGE ADJUSTMENT PROCEDURE

1. Turn OV ADJ (R7) control fully clockwise.

2. The recommended voltage-protection point is 115% of normal power supply operating voltage plus one volt. Compute this value for the operating voltage being used.

3. Turn on the power supply, and raise the output voltage to the desired voltage-protection point; monitor the power supply output voltage to assure correct voltage.

4. Slowly turn the OV ADJ control counter-clockwise until the power supply output voltage, as indicated by the monitoring device, suddenly drops.

5. The voltage-protection point is now set. Remove power supply input power, so that overvoltage protector will reset. Reduce power supply output voltage setting before re-applying input power.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest office of the Lambda Electronics Corp. where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in Lambda power supplies can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not an electronic part, or is not listed, provide a description, function, and location of the part.

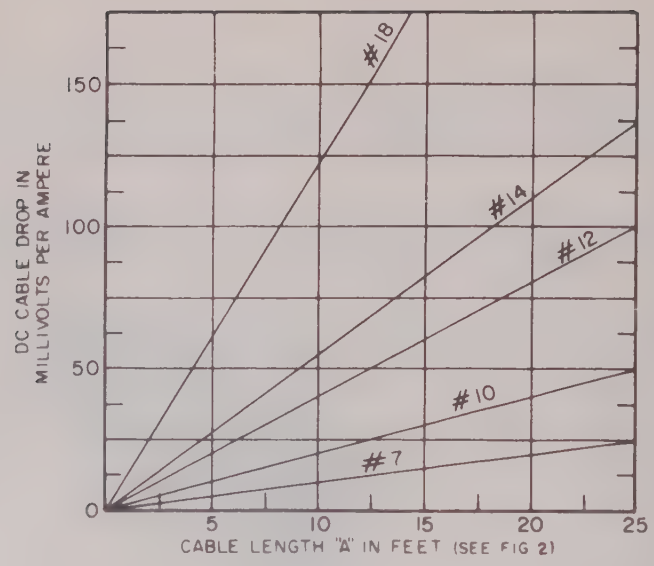


Figure 1. Cable Connection Chart

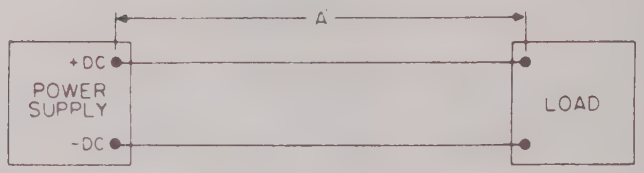
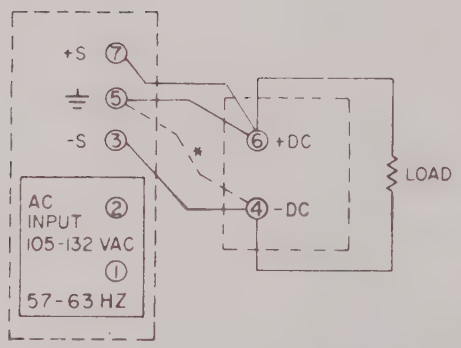
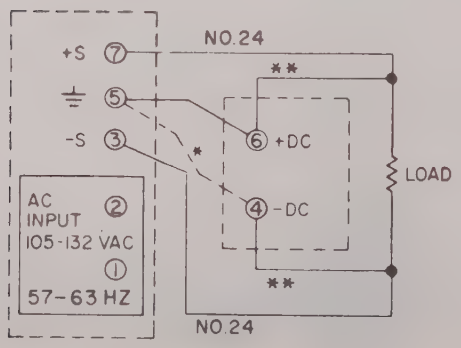


Figure 2. Cable Length "A" in Feet



NOTE
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 5 AND 4

Figure 3. Local Sensing Connections



NOTE.
* FOR NEGATIVE GROUND DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 5 AND 4.
** SELECT WIRE SIZE TO MAINTAIN DESIRED DROPS.

Figure 4. Remote Sensing Connections

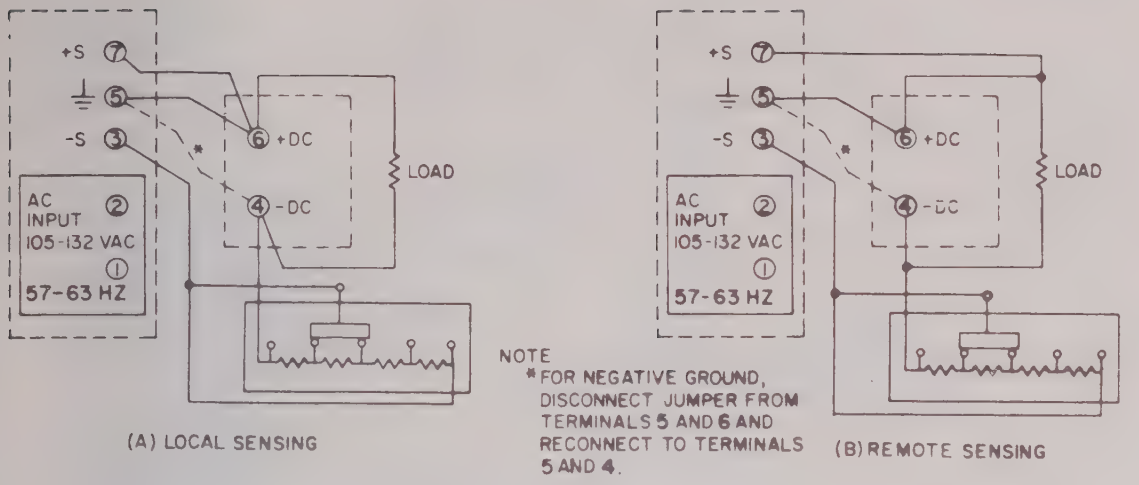


Figure 5. Programmed Voltage with External Resistor

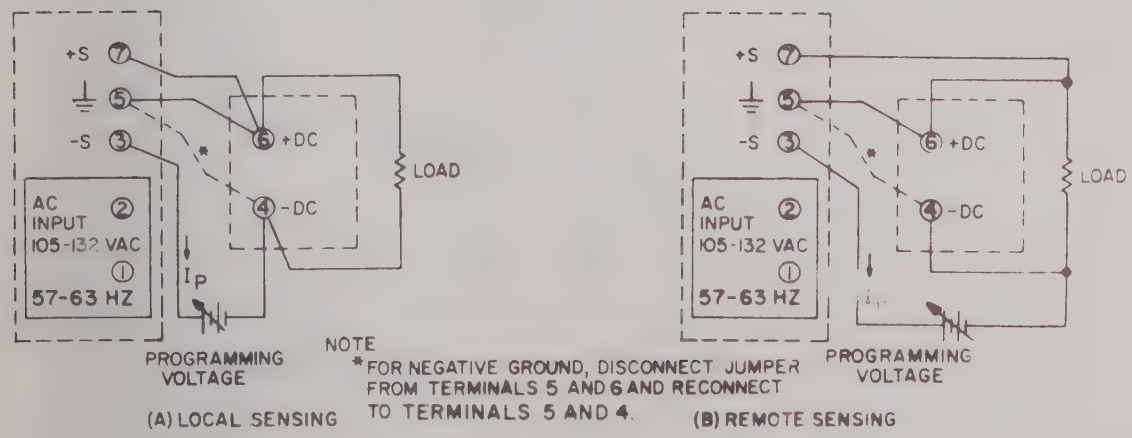


Figure 6. Programmed Voltage, with External Programming Voltage Source

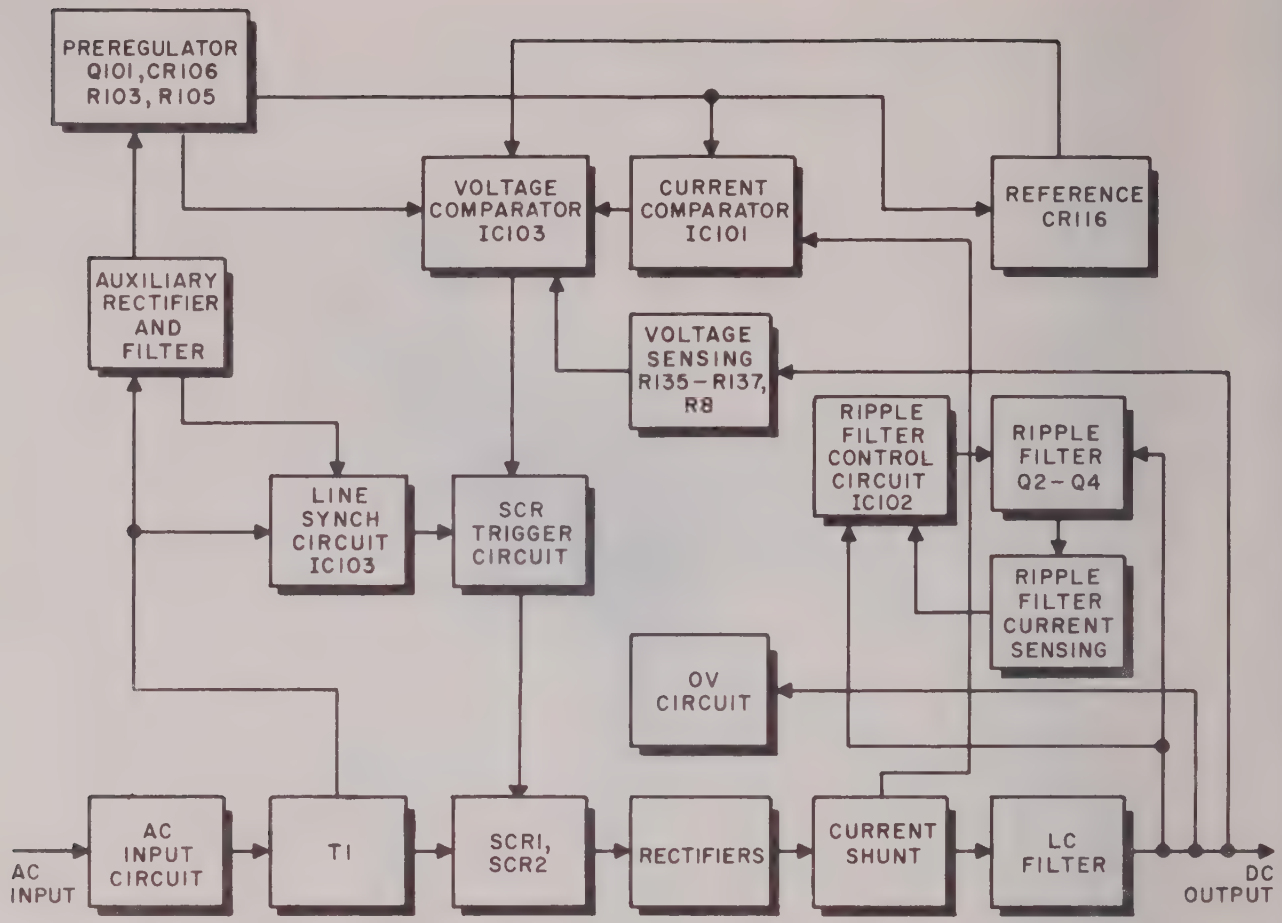


Figure 7. Typical Block Diagram

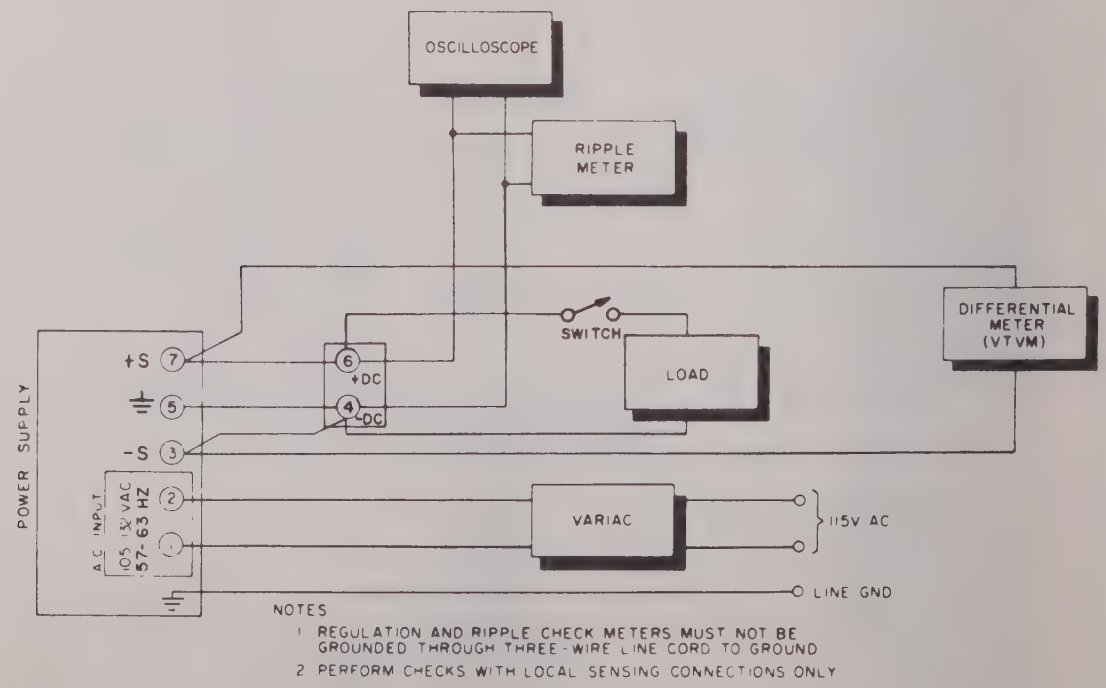


Figure 8. Test Connections for Performance Checks

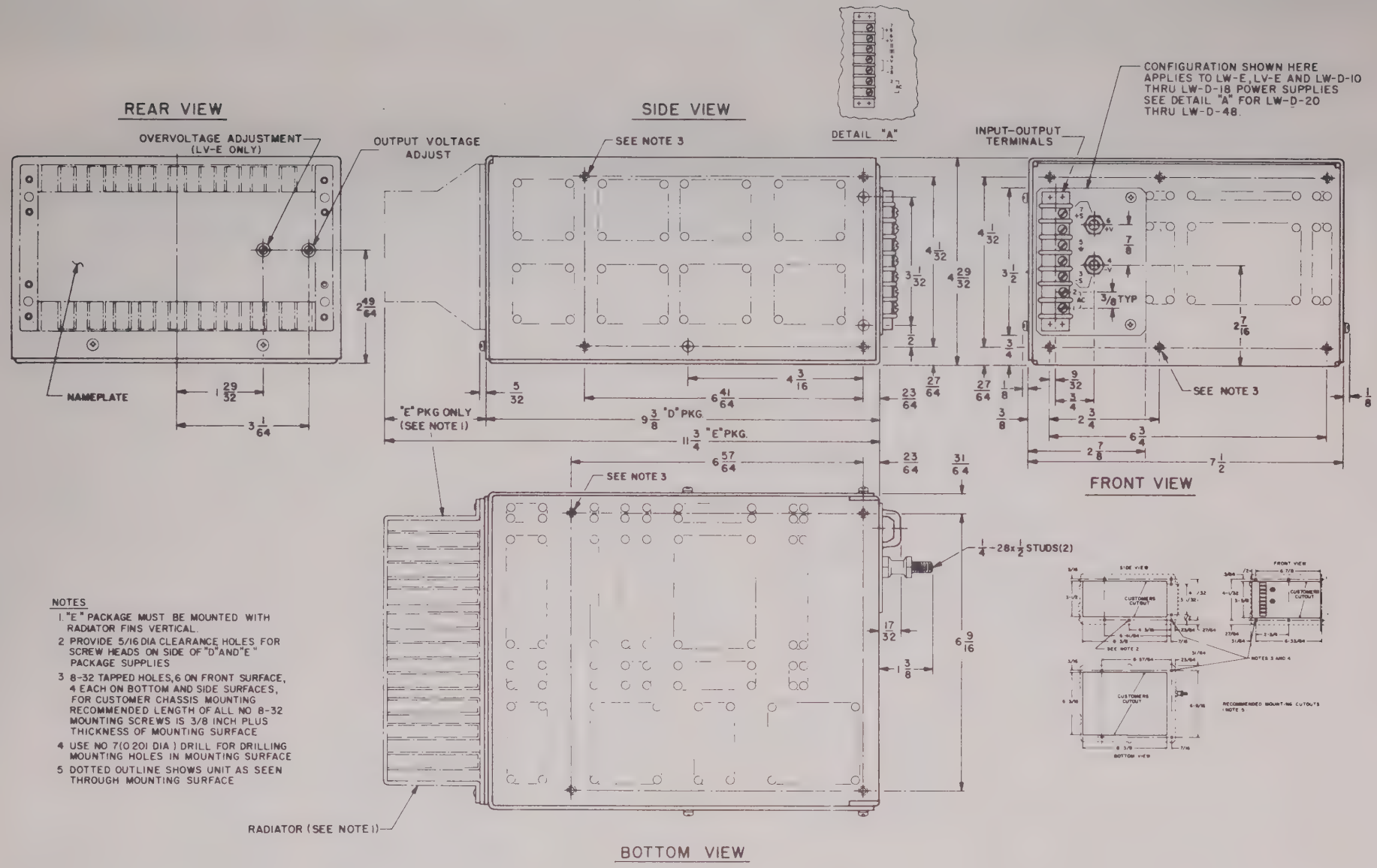
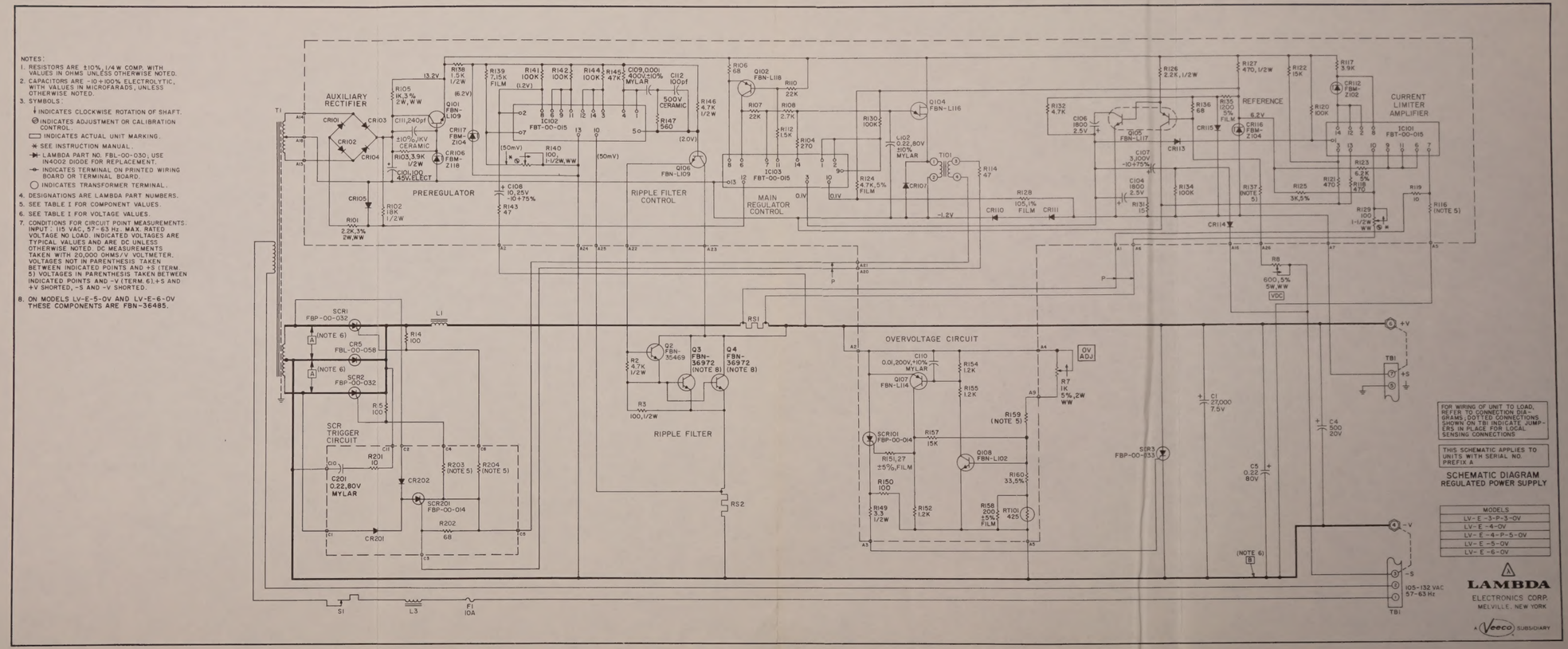

REAR VIEW
OVERVOLTAGE ADJUSTMENT (LV-E ONLY)
OUTPUT VOLTAGE ADJUST
NAMEPLATE
SIDE VIEW
SEE NOTE 3
"E" PKG ONLY (SEE NOTE 1)
"D" PKG.
"E" PKG.
DETAIL "A"
CONFIGURATION SHOWN HERE APPLIES TO LW-E, LV-E AND LW-D-10 THRU LW-D-18 POWER SUPPLIES SEE DETAIL "A" FOR LW-D-20 THRU LW-D-48.
INPUT-OUTPUT TERMINALS
FRONT VIEW
1/4-28x1/2 STUDS(2)
RADIATOR (SEE NOTE 1)
BOTTOM VIEW
NOTES
1. "E" PACKAGE MUST BE MOUNTED WITH RADIATOR FINS VERTICAL.
2. PROVIDE 5/16 DIA CLEARANCE HOLES FOR SCREW HEADS ON SIDE OF "D" AND "E" PACKAGE SUPPLIES
3. 8-32 TAPPED HOLES, 6 ON FRONT SURFACE, 4 EACH ON BOTTOM AND SIDE SURFACES, FOR CUSTOMER CHASSIS MOUNTING RECOMMENDED LENGTH OF ALL NO 8-32 MOUNTING SCREWS IS 3/8 INCH PLUS THICKNESS OF MOUNTING SURFACE
4. USE NO 7 (0.201 DIA.) DRILL FOR DRILLING MOUNTING HOLES IN MOUNTING SURFACE
5. DOTTED OUTLINE SHOWS UNIT AS SEEN THROUGH MOUNTING SURFACE

Figure 9. Outline Drawing

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LV-E-3-P-3-OV THRU
LV-E-6-OV

Model	Voltage Range (Vdc)	Max. Current (Amps) 40°C	50°C	60°C	71°C	Schematic Voltage Measurements A (Vac)	B (Vdc)	Schematic Components R116 ±10%, 1, 4W COMP.	R137 ±3%, 3W WW	R159 ±5%, 1, 4W FILM	R203, R204 ±10%, 1/2W COMP.
LV-E-3-P-3-OV	2.8–3.8	47	39	28	13	9.3	-3.3	1.5K	300	560	4.7
LV-E-4-OV	4 ± 5%	44	39	28	13	10.1	-4.0	2.2K	500	560	5.6
LV-E-4-P-5-OV	4.5 ± 5%	41	38	28	13	11.0	-4.5	2.2K	600	560	7.5
LV-E-5-OV	5 ± 5%	37	34	28	13	11.8	-5.0	2.4K	650	1.2K	7.5
LV-E-6-OV	6 ± 5%	33	30	27	13	13.5	-6.0	3.3K	800 2W	1K	10

NOTES:
1. RESISTORS ARE ±10%, 1/4 W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITORS ARE -10+100% ELECTROLYTIC, WITH VALUES IN MICROFARADS, UNLESS OTHERWISE NOTED.
3. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - INDICATES ACTUAL UNIT MARKING.
   - * SEE INSTRUCTION MANUAL.
   - LAMBDA PART NO. FBL-00-030; USE IN4002 DIODE FOR REPLACEMENT.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
   - INDICATES TRANSFORMER TERMINAL.
4. DESIGNATIONS ARE LAMBDA PART NUMBERS.
5. SEE TABLE I FOR COMPONENT VALUES.
6. SEE TABLE I FOR VOLTAGE VALUES.
7. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 57–63 Hz. MAX. RATED VOLTAGE NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER. VOLTAGES NOT IN PARENTHESIS TAKEN BETWEEN INDICATED POINTS AND +S (TERM. 5) VOLTAGES IN PARENTHESIS TAKEN BETWEEN INDICATED POINTS AND -V (TERM. 6) +S AND +V SHORTED, -S AND -V SHORTED.
8. ON MODELS LV-E-5-OV AND LV-E-6-OV THESE COMPONENTS ARE FBN-36485.



5-Year Guarantee

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

LAMBDA ELECTRONICS CORP.
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